IN THE SPECIFICATION:

Please replace the section of the specification entitled SUMMARY OF THE INVENTION starting on page 2, line 4, and continuing through page 6, line 13, with the following text:

"SUMMARY OF THE INVENTION

To solve the problems, the present inventors examined forming a silicon nitride (Si_3N_4) film using NH_3 and $SiH_2(NH(C_4H_9))_2$ (bis tertiary butyl amino silane: BTBAS, hereinafter) as raw gases. As a result, the inventors have found that the silicon nitride film can be formed at a low temperature of about 600°C and NH_4Cl, which is a cause of metal contamination, is not generated.

However, the present inventors have found that the Si_3N_4 film formed using BTBAS has the following drawbacks.

That is, BTBAS and NH_3 introduced in a furnace are decomposed by heat, and the Si_3N_4 film is formed not only on a wafer but also on an inner wall of a quartz reaction tube and an inner member made of quartz used in the reaction tube. The Si_3N_4 film formed using BTBAS has a strong film stress and the film shrinkage ratio is great. A Si_3N_4 film formed by using DCS and NH_3 and an Si_3N_4 film formed by using BTBAS and NH_3 were compared with each other. Comparison data of a film contraction ratio in percentage is shown in Fig.4, and comparison data of film stress is shown in Fig.5. In Figs.4 and 5, "B" shows an Si_3N_4 film formed by using BTBAS and NH_3, and "D" shows an Si_3N_4 film formed by using DCS and NH_3. The film stress means a tensile force (film stress), and the Si_3N_4 film formed on a reaction furnace quartz comes off by the film stress. The film is shrunk by a high temperature (about 600°C) of the reaction furnace. Since quartz does not shrink or expand by heat and thus, distortion occurs. Therefore, when the Si_3N_4 film becomes thick, a microcrack is generated, and particles are generated on the wafer. A thickness of an Si_3N_4 film that may cause the microcrack is 4,000 Å.

To solve the problem of the particles, it is necessary to perform maintenance in such a manner that whenever a film thickness becomes 4,000 Å, a quartz inner tube 12, a quartz boat 14, and a quartz cap 15 of an vertical-type LPCVD (Low Pressure Chemical Vapor Deposition) film forming apparatus 1 are disassembled, and they are subjected to wet cleaning using HF (hydrogen fluoride) to remove the Si_3N_4 film. When one time film forming operation forms a film of 1,000 Å thickness, it is necessary to perform the maintenance every four film forming operations. Further, there is a problem that it takes 16 hours to complete the maintenance, and this is too long.

According to a first aspect of the present invention, there is provided a semiconductor device manufacturing method including:

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a first step of forming, by a thermal chemical vapor deposition method, a silicon nitride film on an object disposed in a reaction container, with bis tertiary butyl amino silane and NH_3 flowing into the reaction container, and

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a second step of removing, without using plasma, silicon nitride formed in the reaction container, with NF_3 gas flowing into the reaction container.

Preferably, the semiconductor device manufacturing method according to the first aspect of the present invention further comprises the first step after the second step. That is the semiconductor device manufacturing method according to the first aspect of the present invention preferably comprises the first step, thereafter the second step and thereafter the first step again.

Preferably, before the silicon nitride film formed in the reaction container reaches a thickness of 4000 Å, the silicon nitride formed in the reaction container is removed, with NF_3 gas flowing into the reaction container.

Preferably, before the silicon nitride film formed in the reaction container reaches a thickness that generates particles on the object, the silicon nitride formed in the reaction container is removed, with NF_3 gas flowing into the reaction container.

Preferably, the reaction container is made of quartz and/or a member made of quartz is used in the reaction container, and before the silicon nitride film formed on the quartz is increased to a thickness that generates particles on the object, the NF_3 gas is allowed to flow into the reaction container to remove the silicon nitride formed on the quartz. In this case, it is preferable to remove the silicon nitride with NF_3 gas before the thickness of the silicon nitride becomes 4000 Å or larger.

Preferably, the second step is carried out in a state where a pressure in the reaction container is greater than or equal to 10 Torr.

Preferably, the semiconductor device manufacturing method according to the first aspect of the present invention further comprises a step of purging the reaction container using the NH_3 gas at least one of before and after the first step.

Preferably, every time a thickness of the formed silicon nitride film reaches 3000 Å, the silicon nitride film formed in the reaction container is removed, with NF_3 gas flowing into the reaction container.

According to a second aspect of the present invention there is provided a semiconductor manufacturing apparatus including:

a reaction container;

a heater provided outside of the reaction container;

an object mounting device to be disposed in the reaction container;

a first gas charging port for charging bis tertiary butyl amino silane into the reaction container; and

a second gas charging port for selectively charging one of NH_3 and NF_3, thereby performing one of

forming a silicon nitride film, by a thermal chemical vapor deposition method, on an object disposed in the reaction container, with bis tertiary butyl amino silane and NH_3 flowing into the reaction container, and

removing silicon nitride formed in the reaction container, with NF_3 gas flowing into the reaction container.